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Aquatic and marsh plants from the Recôncavo basin of Bahia state, Brazil: checklist and life forms

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Abstract: Aquatic and marsh plants are those that have the capacity to withstand a continuous or periodic submersion in water, at least of their roots. Such plants are thus able to occupy environments that are at least periodically waterlogged. The knowledge about this plant group is still rather incomplete for various parts of Brazil including the Northeast. The present study was conducted in Bahia state, through collections in 20 municipalities within the Recôncavo basin between 2009 and 2015. All species were classified across six life forms. We report 316 species in 206 genera and 71 families, including 11 fern species, with helophytes and emergent being the commonest ones. Collection efforts in aquatic environments in the Recôncavo region added nine families of angiosperms to those already reported in previous studies of such plants in Northeastern Brazil. The region presents a wide variety of aquatic and marsh plants and the respective habitats play an important role in the conservation/maintenance of biodiversity and especially of water bodies in Eastern Bahia.

Key words: wetland flora; Cyperaceae; helophytes

INTRODUCTION

Aquatic and marsh plants are those that have the capacity to withstand a continuous or periodic submersion in water, at least of their roots. Such plants are thus able to occupy environments that are at least periodically waterlogged (Amaral et al. 2008). This is a rather broad concept where even the terms "aquatic" and "marsh" are not strictly defined, and where intermediate conditions are always present. Aquatic plants are also referred to as macrophytes, though there is much disagreement on the use of this term (Cook 1990; Ferreira et al. 2014).

The term "aquatic macrophytes" was first used by Weaver and Clements (1938), who defined them as herbaceous plants growing in water, on waterlogged land, or even in water-saturated soils. Raunkiaer (1934) called water-submerged plants, or those with floating leaves, hydrophytes. Iversen (1936) proposed the term "limnophytes" to describe exclusively higher freshwater plants. Cook et al. (1974) and Cook (1985) used the term "aquatic macrophytes" for all plants whose active photosynthetic parts are permanently, or periodically, submerged or floating on water and which are visible to the naked eye.

In our study, we use the term macrophytes for superior aquatic and marsh plants that spend all or part of their life cycle in water or in a periodically flooded substrate, and that are usually found in ponds, lakes, streams, rivers, on their margins, or nearby.

Because of the wide variation in the distribution of plants in an aquatic environment, several authors have also classified them according to their life forms or habit. On the basis of their position in relation to the water surface and degree of adaptation to the environment they may be divided into free-floating, fixed-floating, free-submerged, fixed-submerged, emergent, or helophytes (Cook 1990). Plants of these groups are distributed along the margins of the waterways in an organized manner, forming division zones from the margins of the body of water to its interior, from the emergent plants to the fixed-submerged ones (Cook 1990; Ferreira et al. 2014).

Brazil has the largest hydrographic network in the world, with the aquatic ecosystems of its rivers and lakes (permanent or temporary) often showing unique characteristics and considerable endemism (Bove et al. 2003). In order to guarantee their preservation as well as improve their management, the study of plants in such environments should be considered of primary importance (Amaral et al. 2008).

Floristic approach has been prevalent in the surveys of aquatic plants in Brazil (Ferreira et al. 2014), carried out for the most part in reservoirs (Pompeo and Moschini-Carlos 2003) of the Southeast, Midwest and Northeast (França et al. 2003; Neves et al. 2006; Amaral et al. 2008, Pivari et al. 2008; Cervi et al. 2009; Pivari et al. 2011; Kufner et al. 2011; Lima et al. 2011; Meyer and Franceschinelli 2011; Valadares et al. 2011; Araújo et al. 2012). These studies demonstrate taxonomic diversity of aquatic plants as well as different methods of morphological adaptation to the aquatic environment (Esteves 1998; Alves et al. 2011.). However, there are large areas of the Brazilian Northeast that still lack basic information such as species lists of aquatic plants (Moura-Jr. et al. 2013) and data sets on their ecology.

The objective of our study was to provide a floristic survey of the freshwater environments of the Recôncavo basin of Bahia, Northeastern Brazil. Such habitats of this region of Bahia are floristically poorly studied and we consider this contribution as a start for further studies of aquatic environments of the coastal regions of the state.

MATERIALS AND METHODS

Study area

The Recôncavo basin of Bahia comprises an area of 11,200 km² and encompasses 20 municipalities (Cabaceiras do Paraguaçu, Cachoeira, Castro Alves, Conceição do Almeida, Cruz das Almas, Dom Macedo Costa, Governador Mangabeira, Maragogipe, Muniz Ferreira, Muritiba, Nazaré, Santo Amaro, Santo Antônio de Jesus, São Felipe, São Félix, São Francisco do Conde, São Sebastião do Passe, Sapeaçu, Saubara, and Varzedo) (SEI 2015). It is part of the Atlantic Forest Phytogeographic Domain, being bordered in the west by the Caatinga Domain. Its soil is commonly known as "massapê baiano", being relatively fertile. The climate is quite varied due to the differences in relief, with coastal areas reaching annual mean temperatures of about 23°C, and the total amount of rainfall exceeding 1,500 mm. Annual mean temperatures inland vary from 18°C in the higher-lying areas and 22°C in lower areas, with an annual rainfall of 1,000 mm (SEI 2015).

Floristic inventory: the inventory was performed during periodic visits to the lotic and lentic aquatic environments in 16 of the 20 municipalities in the Recôncavo basin (Figure 1) from 2009 to 2015 through the rainy and dry seasons.

All collected plant materials were prepared in accordance with the methodology proposed by Mori et al. (1985) and a voucher for each species was deposited at the Herbário do Recôncavo da Bahia (HURB, abbreviation according to Thiers 2015). Plant family classification is that of the APG III (2009) and species nomenclature is that found in the Plant List of Brazil (Lista de Espécies da Flora do Brasil 2015).

Ecological groups were determined according to Cook (1990), using the following categories: helophytes, fixed-floating, free-floating, emergent, epiphytes, fixed-submerged, and free-submerged. Lorenzi (2008) and Moreira and Bragança (2011) were used to recognize the ruderal species.

Taxa identifications were made using specific literature, specimens studies at HURB and HUEFS herbaria (Herbarium of the State University of Feira de Santana, Bahia), and by sending duplicates to plant experts for determination. Photographic records have been taken for all collected species. They will eventually be used in the construction of a multiple-access interactive key for aquatic and marsh plants of the Recôncavo basin in Bahia (http://www2.ufrb.edu.br/chave-plant-aq/).

RESULTS

Floristic composition: a total of 316 plant species, distributed in 206 genera of 71 families have been collected (Table 1), with 11 species of ferns and lycophytes, distributed in eight genera and six families. *Anemia* and *Salvinia* are represented by three and two species, respectively.

Angiosperms are represented by 305 species, in 198 genera and 64 families. Cyperaceae was the most diverse family (39 species), followed by Poaceae (29), Fabaceae (25) and Asteraceae (22). About 80% of angiosperm families had less than five species in the studied environments. The most diverse genera with the highest number of species were *Eleocharis* (12 species) and *Cyperus* (9). About 33%, or 99 of the 295 collected species, were ruderal plants.

The predominant life form was helophyte, with 68.7% of the species, followed by emergent (24%), with the rest of life forms representing less than 3% (Figure 2). Among the helophyte plants the most representative families were Fabaceae (22 species), Asteraceae (18), and Cyperaceae (16), while the most representative genera were *Cuphea* (five species), *Cyperus* (four), and *Ludwigia* (four).

Among the emergent plants Cyperaceae (26 species) and Poaceae (6) were the dominant families, with *Eleocharis* (10 species) and *Cyperus* (7) the most diverse genera. Among the fixed-floating plants, Nymphaeaceae was predominant, with four species of *Nymphaea*. The best represented families of the free-floating plants were Salviniaceae (three

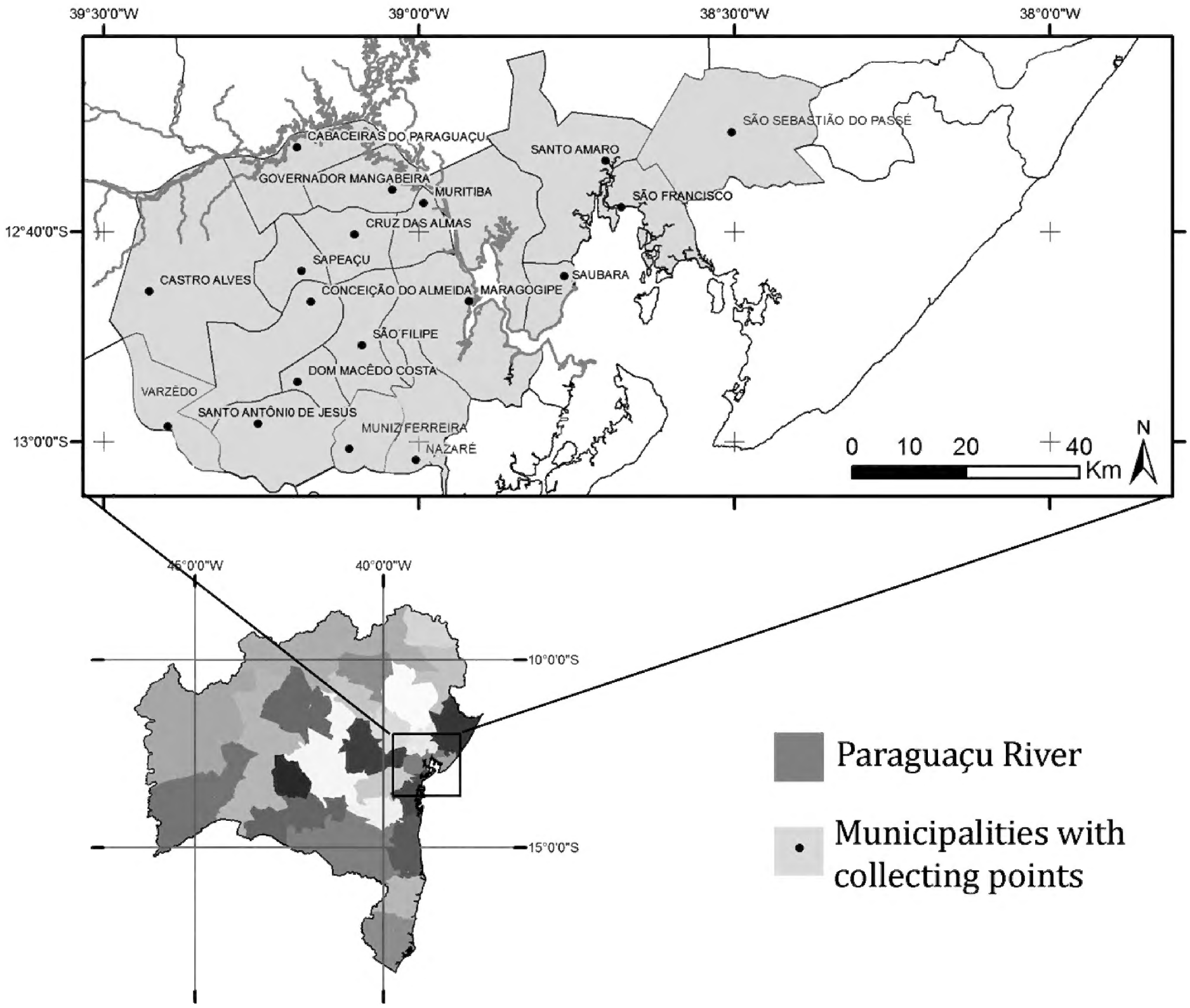

Figure 1. Map of the Recôncavo basin of Bahia. Sampled municipalities are indicated.

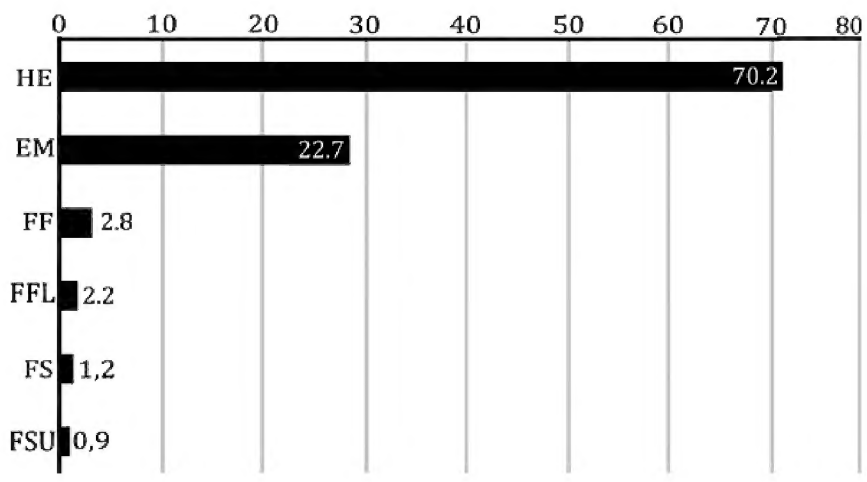

Figure 2. Percentages of life forms of the aquatic species occurring in the Recôncavo basin of Bahia. HE = helophytes; EM = emergent; FF = free floating; FS = free submerged; FFL = fixed floating; and FSU = fixed-submerged.

species) and Araceae (two). In the fixed-submerged category, Hydrocharitaceae was the most important family, with two species, whereas Lentibulariaceae was dominant in the free-submerged category, with two species of *Utricularia*. Among collected plants, *Najas conferta* was the only species with submerged flowers.

Examples of collecting locations and of some of the collected species are illustrated in Figure 3.

DISCUSSION

The aquatic flora of the Recôncavo basin of Bahia is characterized by its high species richness representing about 50% of the 500–600 species estimated for the aquatic environments in Brazil (Agostinho et al. 2005). The present work showed values higher than those recorded both in spot inventories, with 28 to 125 species (França et al. 2003; Neves et al. 2006; Pivari et al. 2008; Kufner et al. 2011; Lima et al. 2011; Valadares et al. 2011; Araújo et al. 2012), and in inventories of larger geographic areas, with a species richness of 70–184 (Cervi et al. 2009; Pivari et al. 2011; Meyer and Franceschinelli 2011).

These results indicate that the region is of fundamental importance for the understanding of ecological processes associated with the aquatic environment, since there is a direct relationship between species richness and its ecosystem functionality (Maestre et al. 2012).

Despite the high degree of species richness, both at species and family levels, the Recôncavo basin of Bahia shows that Cyperaceae is the predominant family (39 spp.), with Poaceae (29 spp.), Fabaceae (25 spp.), and Asteraceae (21 spp.) also prominently represented. The predominance of these families was also observed in several studies involving aquatic plants (França et al. 2003; Neves et al. 2006; Pivari et al. 2008; Cervi et al. 2009; Pivari et al. 2011; Kufner et al. 2011; Lima et al. 2011; Meyer and Franceschinelli 2011; Valadares et al. 2011; Araújo et al. 2012).

In the generic level, species richness varies among the reviewed studies. Apart from the common generic predominance of Cyperaceae (*Cyperus*, *Eleocharis*, and *Rhynchospora*) (França et al. 2003; Cervi et al. 2009; Lima et al. 2011; Meyer and Franceschinelli 2011; Valadares et al. 2011), several studies showed an elevated species richness of *Ludwigia* (Onagraceae) (Neves et al. 2006; Pivari et al. 2008; Pivari et al. 2011; Araújo et al. 2012), *Baccharis* (Asteraceae) (Kufner et al. 2011), and *Utricularia* (Lentibulariaceae) (Moreira et al. 2011).

With the increased collection of aquatic and marsh plants in the Recôncavo basin of Bahia, several important records were made, such as the first records for Bahia state of *Enydra anagallis* Gardner (Asteraceae), *Oxypetalum tubatum* Malme (Apocynaceae), *Caperonia palustris* (L.) A.St.-Hil. (Euphorbiaceae), *Lindernia crustacea* (L.) F.Muell. (Liderniaceae), *Peltaea obsita* (Colla) Krapov. & Cristóbal (Malvaceae), *Ludwigia peploides* (Kunth) P.H.Raven (Onagraceae), *Diodia macrophylla* K.Schum. (Rubiaceae); a re-collection of *Mecardonia procubens* (Plantaginaceae); a new species of *Eleocharis* (Cyperaceae); and an expansion of the distribution range for *Heteranthera rotundifolia*, previously associated with the semi-arid areas of Bahia (Sousa and Giulietti 2014). These findings confirm the view that regular collections over longer period of time (2009-2015) will provide new data about the distribution of various species of higher plants in many parts of Brazil. Obviously, sound biogeographical analyses depend on reliable data about the occurrence of species.

The importance of these collection efforts is evident in the number of new families (nine) that were added to the 72 of aquatic plants previously recorded for Northeastern Brazil and presented in Moura-Júnior et al. (2013). These are: Anemiaceae, Amaryllidaceae, Heliconiaceae, Hypoxidaceae, Iridaceae, Piperaceae, Polygalaceae, Sapindaceae and Vitaceae.

The noticeable presence of ruderal species is probably due to the fact that many aquatic environments were found within livestock raising areas, strongly associated with pasture grasses. Their presence in the aquatic environments is an indicative of irreversible processes of the beginning/intensification of alteration of the original native flora (Kufner et al. 2011). Species richness of Cyperaceae in aquatic environments in the Recôncavo basin of Bahia is another indicator of the anthropogenic influence on the native flora composition (Pivari et al. 2008, Bryson and Carter 2008). The study area is also characterized by the predominance of helophytic species. Helophytes and emergent species, occurring in intermediate environments, are not influenced by alterations in the physical and chemical properties of water (Meyer and Franceschinelli 2011). This may justify their greater presence, since seasonal changes in the aquatic environments do not interfere with their establishment.

In addition to expanding our knowledge of the floristic composition of the aquatic environments in the Recôncavo basin of Bahia, our study will also facilitate a long-term monitoring of aquatic environments and help

Table 1. List of the aquatic and marsh plants and their life forms (LF) for the Recôncavo basin of Bahia. HE = helophytes; EM = emergent; FF = free floating; FS = free submerged; FFL = fixed floating; and FSU = fixed-submerged. * ruderal species. ■ woody or subshrubby species.

Family/Species	LF	*Voucher* (HURB)
Anemiaceae		
Anemia sp. 1	EM	2588
Anemia sp. 2	EM	6644
Anemia sp. 3	EM	7967
Lycopodiaceae		
Lycopodium sp.	HE	8339
Marsileaceae		
Marsilea ancylopoda A.Braun	FFL	1410
Pteridaceae		
Ceratopteris thalictroides (L.) Brongn.	EM	1357
Pteridaceae		
Pityrogramma calomelanos (L.) Link	EM	10174
Salviniaceae		
Azolla filiculoides Lam.	FF	4394
Salvinia auriculata Aubl.*	FF	1344
Salvinia oblongifolia Mart.	FF	1418
Thelypteridaceae		
Thelypteris interrupta (Willd.) K.Iwats.	EM	1237
Acanthaceae		
Hygrophila costata Nees	HE	1329
Justicia laevilinguis (Nees) Lindau	EM	2472
Justicia sp.	EM	4988
Nelsonia canescens (Lam.) Spreng.	HE	1322
Ruellia bahiensis (Nees) Morong*	HE	2920
Ruellia paniculata L.	HE	1323
Alismataceae		
Echinodorus macrophyllus (Kunth) Micheli	EM	1502
Echinodorus palaefolius (Nees & Mart.) J.F. Macbr.	EM	3912
Hydrocleys martii Seub.	EM	2340
Hydrocleys nymphoides (Willd.) Buchenau	FFL	4996
Amaranthaceae		
Alternanthera brasiliana (L.) Kuntze var. *villosa* (Moq.) Kuntze	HE	1576

Continued

Table 1. *Continued.*

Family/Species	LF	*Voucher* (HURB)
Alternanthera philoxeroides (Mart.) Griseb.*	HE	3957
Alternanthera tenella Colla*	HE	991
Amaranthus spinosus L.*	HE	4202
Gomphrena celosioides Mart.*	HE	6589
Amaryllidaceae		
Hymenocallis caribaea (L.) Herb.	HE	4419
Hymenocallis littoralis (Jacq.) Salisb.	HE	4418
Apiaceae		
Eryngium sp.	EM	1355
Pimpinella anisum L.	HE	430
Apocynaceae		
Oxypetalum tubatum Malme	EM	1496
Araceae		
Pistia stratioides L.*	FF	2583
Lemna minuta L.	FF	2573
Montrichiardia linifera (Arruda) Schott	EM	10183
Araliaceae		
Hydrocotyle leucocephala Cham. & Schltdl.	EM	4143
Hydrocotyle bonariensis Lam.	EM	10032
Asteraceae		
Acmella paniculata (Wall. ex DC.) R.K.Jansen	HE	1020
Ageratum conyzoides L.*	HE	2010
Barrosoa betonicaeformis (DC.) R.M.King & H.Rob.	EM	1489
Blanchetia heterotricha DC.	HE	1008
Centratherum punctatum Cass.*	HE	1017
Eclipta prostrata (L.) L.*	HE	1549
Emilia fosbergii Nicolson*	EM	4153
Emilia sonchifolia (L.) DC. ex Wight	HE	10849
Enydra anagallis Gardner	HE	4126
Erechtites hieracifolius (L.) Raf. ex DC.*	HE	4117
Galinsoga parviflora Cav.	HE	3942
Gamochaeta coarctata (Willd.) Kerguélen*	HE	4121
Melanthera latifolia (Gardner) Cabrera	HE	4124
Mikania micrantha Kunth	HE	4118
Platypodanthera melissifolia (DC.) R.M. King & H.Rob.	HE	4152
Pluchea sagittalis (Lam.) Cabrera*	HE	2339
Praxelis pauciflora (Kunth) R.M.King & H.Rob.	HE	1534
Sphagneticola trilobata (L.) Pruski*	HE	1015
Vernonanthura brasiliana (L.) H.Rob.	HE	1346
Asteraceae sp. 1	HE	1533
Asteraceae sp. 2	HE	1473
Asteraceae sp. 4	HE	10248
Begoniaceae		
Begonia cucullata Willd.*	HE	6657
Begonia fischeri Schrank*	HE	
Boraginaceae		
Cordia superba Cham. ■	HE	3467
Heliotropium indicum L.*	HE	2593
Euploca procumbens (Mill.) Diane & Hilger*	HE	4287
Myriopus rubicundus (Salzm. ex DC.) Luebert	HE	4178
Varronia curassavica DC.*	HE	6629
Varronia multispicata (Cham.) Borhidi	HE	10412
Cabombaceae		
Cabomba furcata Schult. & Schult.f.	FF	1413
Caryophyllaceae		
Drymaria cordata (L.) Willd. ex Roem. & Schult.*	HE	8977
Cleomaceae		
Physostemon guianense (Aubl.) Malme	HE	1435
Tarenaya spinosa (Jacq.) Raf.*	HE	4293

Family/Species	LF	*Voucher* (HURB)
Commelinaceae		
Callisia filiformis (M.Martens & Galeotti) D.R.Hunt	HE	435
Commelina benghalensis L.*	HE	2955
Commelina diffusa Burm.f.*	HE	1349
Commelina obliqua Vahl*	HE	3924
Tinantia sprucei C.B.Clarke	HE	4145
Convolvulaceae		
Evolvulus glomeratus Nees & Mart.	HE	2476
Ipomoea asarifolia (Desr.) Roem. & Schult.*	HE	4197
Ipomoea sp.	HE	6613
Cucurbitaceae		
Melothria pendula L.	HE	10411
Cyperaceae		
Bulbostylis sp.	HE	3930
Cyperus articulatus L.	EM	2734
Cyperus haspan L.	HE/EM	2698
Cyperus hermaphroditus (Jacq.) Standl.*	HE/EM	3474
Cyperus iria L.*	EM	4159
Cyperus ligularis L.	EM	3940
Cyperus luzulae (L) Retz.*	HE	4386
Cyperus ochraceus Vahl	HE	2695
Cyperus rotundus L.*	EM	2977
Cyperus surinamensis Rottb.*	HE/EM	1440
Eleocharis acutangula (Roxb.) Schult.*	EM	4389
Eleocharis atropurpurea (Retz.) J.Presl & C.Presl	HE	1474
Eleocharis elegans (Kunth) Roem. & Schult.*	EM	6591
Eleocharis filiculmis Kunth	HE/EM	1454
Eleocharis geniculata (L.) Roem. & Schult.	EM	4161
Eleocharis interstincta (Vahl) Roem. & Schult.*	EM	2585
Eleocharis minima Kunth	EM	1459
Eleocharis mutata (L.) Roem. & Schult.	EM	3945
Eleocharis nudipes (Kunth) Palla	EM	2464
Eleocharis sellowiana Kunth*	HE	8392
Eleocharis sp.	EM	2721
Eleocharis sp. nov.	HE	1430
Fimbristylis autumnalis (L.) Roem. & Schult.*	HE/EM	4384
Fimbristylis complanata (Retz.) Link	HE	1449
Fimbristylis cymosa R.Br.	HE	4390
Fuirena umbellata Rottb.*	EM	1446
Kyllinga brevifolia Rottb.*	HE	2717
Kyllinga vaginata Lam.	HE	1481
Oxycaryum cubense (Poepp. & Kunth) Lye	EM	4395
Pleurostachys sparsiflora Kunth	HE	3917
Pycreus polystachyos (Rottb.) P.Beauv.*	EM	1450
Pycreus unioloides (R.Br.) Urb.	HE	2696
Rhynchospora gigantea Link	EM	4206
Rhynchospora holoschoenoides (Rich.) Herter	EM	1569
Rhynchospora nervosa (Vahl) Boeckeler*	EM	2981
Rhynchospora tenuis Link	EM	2477
Rhynchospora sp.	EM	1493
Scleria bracteata Cav.	EM	6632
Scleria gaertneri Raddi*	HE	1106
Eriocaulaceae		
Tonina fluviatilis Aubl.	EM	1538
Euphorbiaceae		
Acalypha brasiliensis Müll.Arg.	HE	4149
Astraea lobata (L.) Klotzsch*	HE	3452
Caperonia palustris (L.) A.St.-Hil.	HE	2592
Cnidoscolus sp.	HE	10813
Croton heliotropiifolius Kunth	HE	1428

Continued

Table 1. *Continued.*

Family/Species	LF	*Voucher* (HURB)
Dalechampia coriacea Klotzsch ex Müll.Arg.	HE	4199
Euphorbia heterophylla L.*	HE	2936
Euphorbia hirta L.*	HE	432
Euphorbia hyssopifolia L.*	HE	1105
Microstachys corniculata (Vahl) Griseb.	HE	10179
Fabaceae		
Aeschynomene sp. ■	HE	11030
Aeschynomene filosa Mart. ■	HE	1474
Aeschynomene scabra G.Don ■	HE	2490
Aeschynomene sensitiva Sw. ■	HE	6539
Calopogonium sp.	HE	7966
Chamaecrista nictitans (L.) Moench*	HE	10874
Chamaecrista repens (Vogel) H.S.Irwin & Barneby	EM	2485
Crotalaria retusa L.*	EM	4440
Desmodium adscendens (Sw.) DC.*	HE	3451
Desmodium barbatum (L.) Benth.	HE	10797
Desmodium incanum (Sw.) DC.*	HE	6537
Desmodium uncinatum (Jacq.) DC.*	HE	6540
Dioclea virgata (Rich.) Amshoff	HE	7207
Macroptilium lathyroides (L.) Urb.*	HE	6587
Mimosa pigra L.*	HE	3468
Mimosa pudica L.*	HE	1335
Neptunia plena (L.) Benth.*	HE	2465
Rhynchosia minima (L.) DC.	HE	1100
Senna obtusifolia (L.) H.S.Irwin & Barneby*	HE	4201
Stylosanthes gracilis Kunth*	HE	6611
Stylosanthes guianensis (Aubl.) Sw.*	HE	2478
Stylosanthes macrocephala M.B.Ferreira & Sousa Costa	HE	2489
Stylosanthes scabra Vogel	EM	4192
Vigna luteola (Jacq.) Benth.	HE	10909
Zornia latifolia Sm.	HE	6538
Gentianaceae		
Coutoubea spicata Aubl.	HE	7000
Schultesia gracilis Mart.	HE	6604
Schultesia guianensis (Aubl.) Malme	EM	1495
Haloragaceae		
Myriophyllum aquaticum (Vell.) Verdc.*	FSU	7204
Heliconiaceae		
Heliconia psittacorum L.f.	HE	6636
Hydrocharitaceae		
Najas conferta (A.Braun) A.Braun	FF/FS	2908
Apalanthe granatensis (Bonpl.) Planch.	FSU	6584
Egeria densa Planch.*	FSU	4120
Limnobium laevigatum (Humb. & Bonpl. ex Willd.) Heine	FF	10009
Hydroleaceae		
Hydrolea spinosa L.*	HE	2344
Hypoxidaceae		
Hypoxis decumbens L.*	HE	2657
Iridaceae		
Cipura paludosa Aubl.	HE	10840
Trimezia martinicensis (Jacq.) Herb.	HE	6638
Lamiaceae		
Hyptis sp. 1	HE	4127
Hyptis sp. 2	HE	3453
Hyptis sp. 3	HE	1338
Leonotis nepetifolia (L.) R.Br.*	HE	1577
Marsypianthes chamaedrys (Vahl) Kuntze	HE	10850
Mesosphaerum pectinatum (L.) Kuntze	HE	6607
Rhaphiodon echinus Schauer*	HE	434
Lamiaceae sp.	HE	2660
Lentibulariaceae		
Utricularia foliosa L.	FS	2006
Utricularia gibba L.	FS	10860
Linderniaceae		
Lindernia crustacea (L.) F.Muell.	HE	6646
Torenia thouarsii (Cham. & Schltdl.) Kuntze	EM	2575
Loganiaceae		
Spigelia anthelmia L.*	HE	1472
Lythraceae		
Ammannia latifolia L.	HE	1348
Cuphea brachiata Koehne	HE	2470
Cuphea pascuorum Koehne	HE	1425
Cuphea racemosa (L.f.) Spreng*	HE	2007
Cuphea strigulosa Kunth	HE	2919
Pleurophora anomala (A. St.-Hil.) Koehne	HE	4125
Rotala ramosior (L.) Koehne	HE	4396
Malvaceae		
Corchorus argutus Kunth*	HE	2950
Malachra sp.	HE	10893
Pavonia sp.	HE	10180
Peltaea obsita (Colla) Krapov. & Cristóbal	HE	10160
Sida rhombifolia L.*	HE	4436
Sida ulei Ulbr.	HE	6649
Sida sp.	HE	1572
Sidastrum micranthum (A.St.-Hil.) Fryxell*	HE	7199
Triumfetta semitriloba Jacq.* ■	HE	10250
Urena lobata L.*	EM	1333
Waltheria sp.	HE	10160
Wissadula amplissima (L.) R.E.Fr.	HE	1107
Malvaceae sp.	HE	2912
Marantaceae		
Calathea sp.	HE	2895
Mayacaceae		
Mayaca fluviatilis Aubl.	EM	8344
Mayaca longipes Mart. ex Seub.	FS/FSU	11035
Melastomataceae		
Clidemia hirta D.Don ■	HE	7205
Desmoscelis villosa (Aubl.) Naudin	HE	10169
Leandra sp.	EM	10167
Marcetia taxifolia (A.St.-Hil.) DC.	HE	9381
Pterolepis glomerata (Rottb.) Miq.	HE	10794
Tibouchina lhotzkyana (C.Presl) Cogn.	HE	7206
Rhynchanthera dichotoma (Desr.) DC.	HE	98
Menyanthaceae		
Nymphoides indica (L.) Kuntze*	FFL	7197
Molluginaceae		
Mollugo verticillata L.*	EM	1441
Nymphaeaceae		
Nymphaea cf. *amazonum* Mart. & Zucc.	FFL	2724
Nymphaea lingulata Wiersema	FFL	1443
Nymphaea pulchella DC.	FFL	1417
Nymphaea rudgeana G.Mey	FFL	1464
Ochnaceae		
Sauvagesia erecta L.	HE	1490
Onagraceae		
Ludwigia erecta (L.) H.Hara	EM	4129
Ludwigia hyssopifolia (G.Don) Exell	HE	6612
Ludwigia leptocarpa (Nutt.) H.Hara*	HE	2906
Ludwigia peploides (Kunth) P.H.Raven	HE	3913

Continued

Table 1. *Continued.*

Family/Species	LF	*Voucher* (HURB)
Ludwigia octovalvis (Jacq.) P.H.Raven*	HE	1535
Orchidaceae		
Pelexia sp.	HE	10703
Orobanchaceae		
Melasma melampyroides (Rich.) Pennell	HE	10713
Oxalidaceae		
Oxalis puberula Nees & Mart.	HE	7968
Passifloraceae		
Passiflora foetida L.*	HE	10419
Phyllanthaceae		
Phyllanthus stipulatus (Raf.) G.L.Webster	EM	1478
Phytolacaceae		
Microtea paniculata Moq.*	HE	2897
Piperaceae		
Peperomia pellucida (L.) Kunth	HE	2584
Piper caldense C.DC.	HE	3460
Piper sp.■	HE	2927
Plantaginaceae		
Achetaria ocymoides (Cham. & Schltdl.) Wettst.	HE	1142
Achetaria scutellarioides (Benth.) Wettst.	HE	8349
Angelonia salicariifolia Bonpl.	HE	7211
Bacopa gratioloides (Cham.) Edwall	EM	1547
Conobea scoparioides (Cham. & Schltdl.) Benth.	HE	8350
Mecardonia procumbens (Mill.) Small	HE	2591
Scoparia dulcis L.*	HE	425
Stemodia foliosa Benth.	HE	2017
Stemodia maritima L.	HE	2660
Stemodia sp.	HE	4198
Poaceae		
Andropogon bicornis L.*	HE	2944
Chloris cf. *barbata* Sw.*	HE	1475
Dichanthelium sciurotoides (Zuloaga & Morrone) Davidse	HE	2018
Digitaria cf. ciliaris (Retz.) Koeler*	HE	437
Echinochloa colona (L.) Link*	HE	1476
Echinochloa crusgalli (L.) P.Beauv.	HE	2948
Echinocloa sp.	HE	2947
Eragrostis ciliaris (L.) R.Br.*	HE	10035
Eragrostis hypnoides (Lam.) Britton, Sterns & Poggenb.	HE	1480
Hymenachne amplexicaulis (Rudge) Nees*	EM	2652
Hymenachne pernambucensis (Spreng.) Zuloaga	HE	10415
Leersia hexandra Sw.*	HE	2589
Leptochloa virgata (L.) P.Beauv.*	HE	1421
Luziola caespitosa Swallen	HE	2943
Megathyrsus maximus (Jacq.) B.K.Simon & S.W.L.Jacobs	HE	2963
Panicum aquaticum Poir.*	HE	10030
Paspalidium geminatum (Forssk.) Stapf	EM	3938
Paspalum paniculatum L.*	HE	4146
Paspalum millegrana Schrad. ex Schult.	HE	4430
Paspalum conjugatum P.J.Bergius	HE	10249
Rugoloa pilosa (Sw.) Zuloaga	HE	3454
Sacciolepis myuros (Lam.) Chase	HE	1556
Setaria parviflora (Poir.) Kerguélen*	EM	2938
Sporobolus indicus (L.) R.Br.*	EM	2678
Steinchisma hians (Elliott) Nash	HE	1431
Steinchisma laxum (Sw.) Zuloaga	EM	1555
Steinchisma decipiens (Nees ex Trin.) W.V.Br.	EM	1340
Trichanthecium cyanenscens (Nees ex Trin.) Zuloaga & Morrone	HE	9370
Urochloa sp.	HE	1110
Polygalaceae		
Polygala paniculata L.*	HE	1471
Polygala sp.	HE	1544
Polygonaceae		
Polygonum ferrugineum Wedd.	HE	10243
Polygonum hispidum Kunth	HE	1437
Polygonum punctatum Elliott	EM	7210
Pontederiaceae		
Eichhornia crassipes (Mart.) Solms	FF/EM	4291
Eichornia heterosperma Alexander	EM	10861
Eichhornia paniculata (Spreng.) Solms*	EM	4163
Heteranthera multiflora (Griseb.) C.N.Horn	EM	10864
Heteranthera peduncularis Benth.	EM	3955
Heteranthera reniformis Ruiz & Pav.*	EM	2733
Heteranthera rotundifolia (Kunth) Griseb.	EM	10017
Portulacaceae		
Portulaca umbraticola Kunt	HE	3941
Talinum paniculatum (Jacq.) Gaertn.*	HE	4443
Rubiaceae		
Borreria ocymifolia (Roem. & Schult.) Bacigalupo & E.L.Cabral	HE	1494
Borreria scabiosoides Cham. & Schltdl.	HE	2651
Borreria verticillata (L.) G.Mey.*	HE	2673
Diodella apiculata (Willd. ex Roem. & Schult.) Delprete	HE	2479
Diodia macrophylla K.Schum.	HE	9641
Diodia saponariifolia (Cham. & Schltdl.) K.Schum.	HE	9360
Gonzalagunia dicocca Cham. & Schltdl.	HE	1086
Perama hirsuta Aubl.	HE	9367
Richardia grandiflora (Cham. & Schltdl.) Steud.*	HE	2923
Sabicea grisea Cham. & Schltdl. ■	HE	6647
Rubiaceae sp.	HE	6649
Sapindaceae		
Serjania sp. 1	HE	1108
Serjania sp. 2	HE	2898
Serjania sp. 3	HE	1108
Solanaceae		
Cestrum nocturnum L. ■	HE	7195
Physalis angulata L.*	HE	1501
Schwenckia americana Rooyen ex L.	HE	1001
Solanum palinacanthum Dunal	HE	10846
Solanum thomasiifolium Sendtn. ■	HE	10237
Typhaceae		
Typha latifolia L.	HE	2727
Urticaceae		
Boehmeria cylindrica (L.) Sw.	HE	4148
Pilea pubescens Liebm.	HE	6639
Verbenaceae		
Lantana camara L.*	HE	1112
Lippia sp.	HE	3456
Priva lappulacea (L.) Pers.	HE	4445
Stachytarpheta angustifolia (Mill.) Vahl	HE	4188
Stachytarpheta bicolor Hook.f.	HE	2680
Vitaceae		
Cissus albida Cambess. ■	HE	3443
Cissus spinosa Cambess. ■	HE	7203
Xyridaceae		
Xyris macrocephala Vahl	EM	1498
Xyris sp.	EM	1455
Zingiberaceae		
Hedychium coronarium J.Koenig*	EM	2916

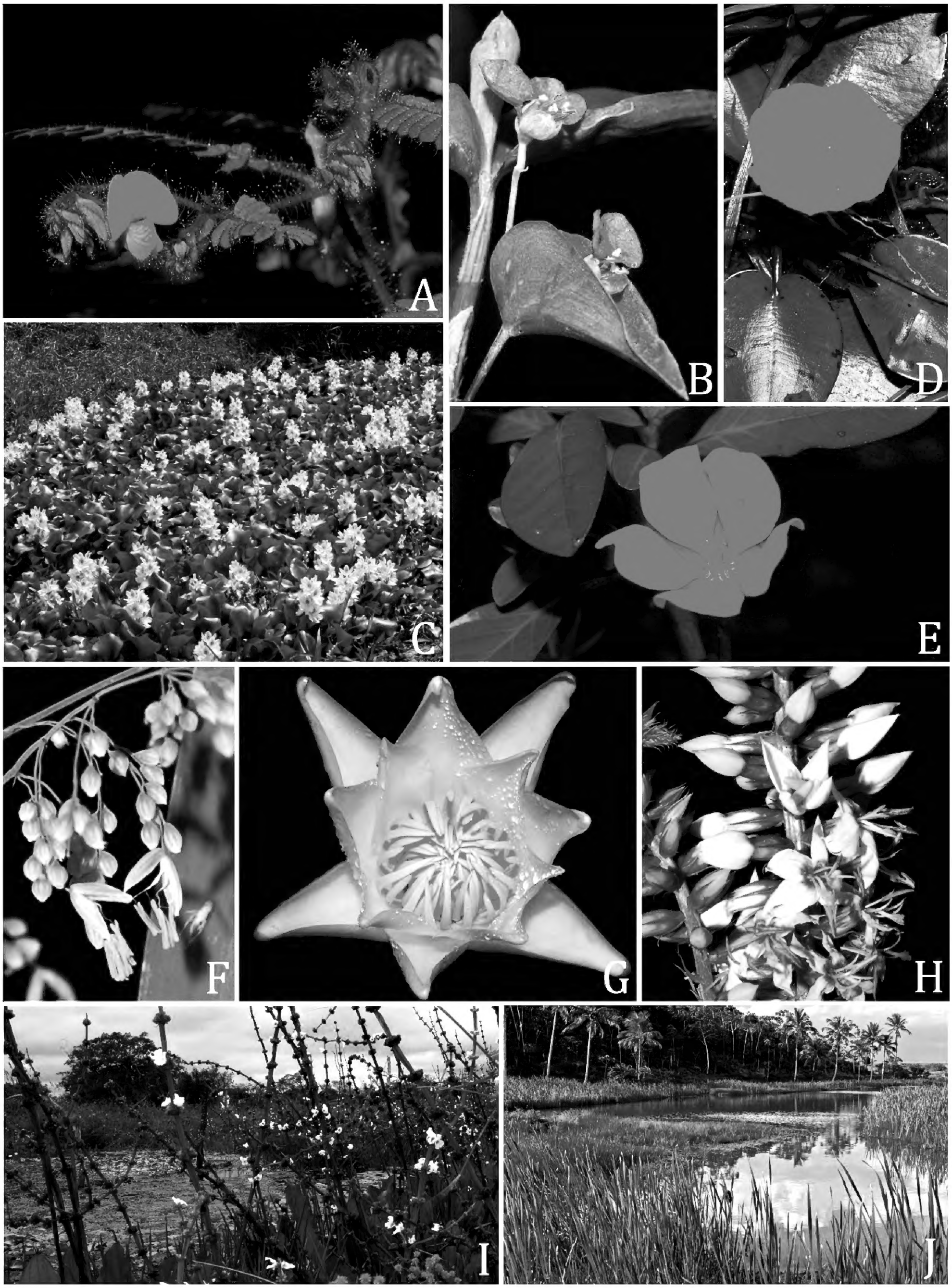

Figure 3. Aquatic and marsh plants photographed at the Recôncavo basin. **A**: *Aeschynomene* sp. (Fabaceae). **B**: *Commelina diffusa* (Commelinaceae). **C**: *Eichhornia crassipes* (Pontederiaceae). **D**: *Hydrocleys nymphoides* (Alismataceae). **E**: *Ludwigia peploides* (Onagraceae). **F**: *Luziola caespitosa* (Poaceae). **G**: *Nymphaea lingulata* (Nymphaeaceae). **H**: *Coutoubea spicata* (Gentianaceae). **I**: Lake in Sapeaçu municipality. **J**: River in Muritiba municipality. (Figures A-F, H-I: L.Y.S. Aona; figures G, J: V. Bittrich).

researchers in dealing with their water management, essential for the conservation and maintenance of any body of water.

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